CW Fiber Laser

User's Manual

Product CRFL
Platform M701

UM n°36 – Rev.03 – March 2014

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WARNING

This product might be a class III-B or class IV fiber laser. Refer to the front panel label (or the lid) of your device.

Invisible laser radiation when the product is operating with fiber disconnected.

AVOID DIRECT EXPOSURE TO THE BEAM: Never operate with a broken fiber or with fiber disconnected.

DO NOT OPEN THE DEVICE, WARRANTY VOID IF THE MODULE HAS BEEN OPENED.

BEFORE ANY USE OF THE DEVICE, ENSURE YOU HAVE READ THE USER MANUAL AND SPECIALLY THE SAFETY CONSIDERATIONS.

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1. General Information

1.1. About this manual

1.1.1. Purpose

This documentation is provided as an instruction manual to Keopsys' customers and potential customers only.

The contents of this publication may not be reproduced in any part without prior written permission of Keopsys.

This documentation is provided "as is" without any express or implied warranty of any kind.

It includes general safety considerations, optical and electrical connections for installing the product.

Keopsys company is committed to conduct its business with the ISO 14000 environmen-tal program.

For this, we design our product and service to minimize use of hazardous materials and to enable recycling and re-use.

This manual is constituted with matters which can be recycled.

1.1.2. Prerequisites

It is assumed that the user is familiar with fiber optic technology and laser safety issues.

1.2. General safety considerations

1.2.1. Terms and symbols in this manual

The following terms and symbols may appear throughout this manual:

WARNING	Warning statements identify conditions or practices that could certainly result in injury.
ATTENTION	Caution statements identify conditions or practices that could result in damage to this product or other property.

1.2.2. Terms on the product

The following terms may appear on the product:

DANGER	The label indicates the presence of danger.
CAUTION	Indicates an injury hazard not immediately present when you read the label.
ATTENTION	Indicates a hazard to property, including the product itself.

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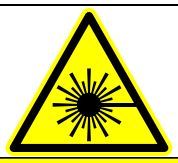
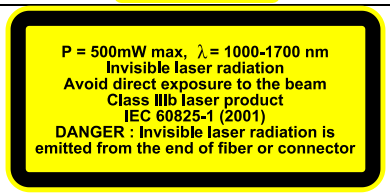
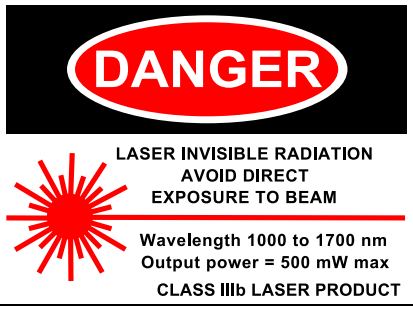
1.2.3. Class III-B Laser product

The KEOPSYS products comply with the European and International normalization about laser safety and optical fibers telecommunication systems safety:

- 825-1 IEC (2007) , EN 60825-1 (2008)
- 825-1 IEC (2007) , EN 60825-2 (2008)

So following symbols appear on the product:

	LASER WARNING Label (located on the front panel or the lid)
	EXPLANATORY Label LASER RADIATION WARNING Label (located on the front panel or the lid)
	ELECTROSTATIC Label (located on the rear panel or the lid)
	United States Label (located on the front panel or the lid)

Class III-B Laser safety:

WARNING	**Class III-b laser product** may emit 500 mW max of light in the 1000 nm -1700 nm range.
WARNING	The use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure
WARNING	Use appropriated and standardized laser glasses.
WARNING	**The use of optical instruments with this product will increase eye hazard**. Do not under any circumstances look directly into the fiber end of an optical cable attached to the optical output while the device is in use.This may cause permanent eye or skin damages and possible loss of eyesight.
WARNING	**Disable the laser output before connecting or disconnecting an optical fiber cable on the instrument.**
WARNING	**Do not open the device.** Invisible laser radiation could affect the operator if this condition is not respected.
WARNING	**Any check of the optical connectors** must be processed when the laser source is unplugged and by using filtering observation optical systems.
WARNING	The device must operate without any impact or vibration.

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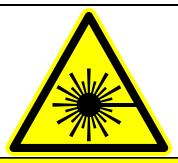
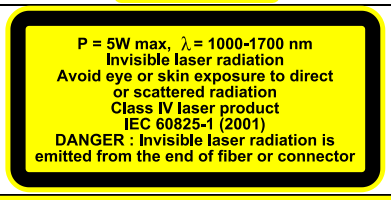
1.2.4. Class IV Laser product

The KEOPSYS products comply with the European and International normalization about laser safety and optical fibers telecommunication systems safety:

- 825-1 IEC (2007) , EN 60825-1 (2008)
- 825-1 IEC (2007) , EN 60825-2 (2008)

So following symbols appear on the product:

	LASER WARNING Label (located on the front panel or the lid)
	EXPLANATORY Label LASER RADIATION WARNING Label (located on the front panel or the lid)
	ELECTROSTATIC Label (located on the rear panel or the lid)
	United States Label (located on the front panel or the lid)

Class IV Laser safety:

WARNING	**Class IV laser product** may emit more than 500 mW of light in the 1000 nm -1700 nm range.
WARNING	The use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
WARNING	Use appropriated and standardized laser glasses.
WARNING	**The use of optical instruments with this product will increase eye hazard**. Do not under any circumstances look directly into the fiber end of an optical cable attached to the optical output while the device is in use for this may cause permanent eye or skin damages and possible loss of eyesight.
WARNING	**Disable the laser output before connecting or disconnecting an optic fiber cable on the instrument.**
WARNING	**Do not open the device.** Invisible laser radiation could affect the operator if this condition is not respected.
WARNING	**Any check of the optical connectors** must be processed when the laser source is not supplied and by filtering observation optical systems.
WARNING	The device must operate without any impact or vibration.

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1.2.5. Electric Safety

WARNING	Before connecting your device make sure that the socket outlet is properly grounded
WARNING	Before connecting your device make sure that your line voltage agrees with the voltage given on documentation and sticker on the unit and that the right fuse has been inserted
WARNING	Before applying power to your device make sure that the protective connector of the 3 conductor mains power cord is correctly connected to the protective earth contact of the socket outlet. Never use a mains power not supplied by KEOPSYS. IMPROPER GROUDING CAN CAUSE ELECTRIC SHOCK with damage to your health and even death.
WARNING	Never use a unit without its complete package including all covers ; ask if necessary for a replacement part.

1.2.6. Other safety considerations

WARNING	The device has been designed according the standard relative to "Safety requirements for electrical equipment for measurement, control and laboratory use" Do not use the device out of this type of application.
WARNING	The device is designed for an inside application.
WARNING	The device must be properly located on a flat horizontal surface.
WARNING	The device must be located in order to keep free the fan air outlets at the rear of the box.
ATTENTION	The environmental conditions during the use of the device must comply with those described in the technical specification.

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2. Installation and Service

2.1. Unpacking

The package should be opened in an electrostatic discharge (ESD) free environment. The operator should be properly grounded at the same level as the working surface. The device should be unpacked on an ESD free surface. The laser source electronics and pump diodes can be seriously damaged by electro-static discharge. Even if damage is not immediately apparent, it may shorten the lifetime of the unit, in particular the pump laser.

Handle the device with care when unpacking. Hold the box in one hand and the fiber in the other hand when pulling out the unit from its packaging. Lay down the device and the fiber on a horizontal surface.

Before any operation, make sure the device is free from mechanical damage, which may have occurred during transportation.

The device is supplied by Keopsys completely assembled and tested.

Keep the original shipping container for use in case the instrument needs to be returned to Keopsys for repair or servicing.

2.2. Standard accessories

The product comes with the following standard accessories:

- User's manual (this manual)
- Test report
- Interface cable or interface box (optional)

2.3. Installation

WARNING	A professional familiar with optical fiber technology and laser equipment must perform the installation.
WARNING	Before any installation, make sure that you have completely read the general safety considerations.
WARNING	Use appropriated and standardized laser glasses.

2.3.1. Connecting fibers

WARNING	Invisible laser radiation. Avoid direct exposure to the beam. Direct viewing of the beam may cause serious eye and skin damages and possible vision loss; never operate system with fiber disconnected or a broken fiber. Do not view fiber end directly when optical instrument is powered.

Follow the steps to connect optical fiber:

1. Ensure that the device is not powered up.
2. Remove protection caps from optical connectors.
3. The device is delivered with fiber connectors (defined in the technical specification). To connect this device to others equipment, please ensure that the type of connectors is compatible with your device ones.
4. Clean both optical connectors (see §2.3.3).
5. Connect cleaned optical connectors to the device.

2.3.2. Connect a collimator (optional)

WARNING	Invisible laser radiation. Avoid direct exposure to the beam. Direct viewing of the beam may cause serious eye and skin damages and possible vision loss; never operate system with fiber disconnected or a broken fiber. Do not

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	view fiber end directly when optical instrument is powered.

Follow the steps to connect optical fiber:

1. Ensure that the device is not powered up.
2. Remove protection caps from optical connectors.
3. Clean the optical connector (see §2.3.3).
4. Connect cleaned optical connector to the collimator.

2.3.3. Cleaning optical connector

WARNING	Make sure the device is switched OFF.

With lint-free paper:

- Use lint-free paper
- Fold it into a corner
- Drop the paper into ethanol
- Clean delicately the polished surface of the connector in a circular motion
- Blow dry air in order to remove any remaining dust

With optical Fiber Connector Cleaner (CLETOP) *:

- See user instruction enclosed with Cletop cleaner

Make sure that the connector does not touch any surface when connecting it.

Check with a fiber connector microscope

Available at Keopsys:

* Connector Cleaner CLETOP.

Order with reference CS-OUT-028-00 to your sales contact.

For spares patch cords, contact our sales team.

2.4. Power Up

2.4.1. First time power-up

To power up the device, you should follow those steps (see §3 for device elements location):

1. Check the device is on heat sink at least.
2. Plug the interface cable to the device.
3. Check the 0/1 button is on 0 position
4. Plug the interface cable to the supply (see §4.1 for specifications)
5. Switch on the power supply
6. Connect the sub-D9 connector to the computer
7. Start the remote control software (see its own manual)
8. Connect the output pigtail to a powermeter or bolometer device which can support laser nominal power (see device test report). Beware of the cleaning of the optical connector (see §2.3.3). Make sure that the connector surface is carefully cleaned. Do not operate the laser with a damaged connector.
9. Switch on your optical source.
10. Turn on the 0/1 button on interface cable. Beware the device is now emitting.
11. Select the ACC mode on remote control software, and set the current to the nominal current (see device test report). Then start the device on remote control software.

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2.4.2. Shut down

To shut down the device, you should follow those steps:

1. Turn off the 0/1 button on interface cable.
2. Switch off the power supply.
3. Unplug and protect optical connector.
4. Unplus interface cable.

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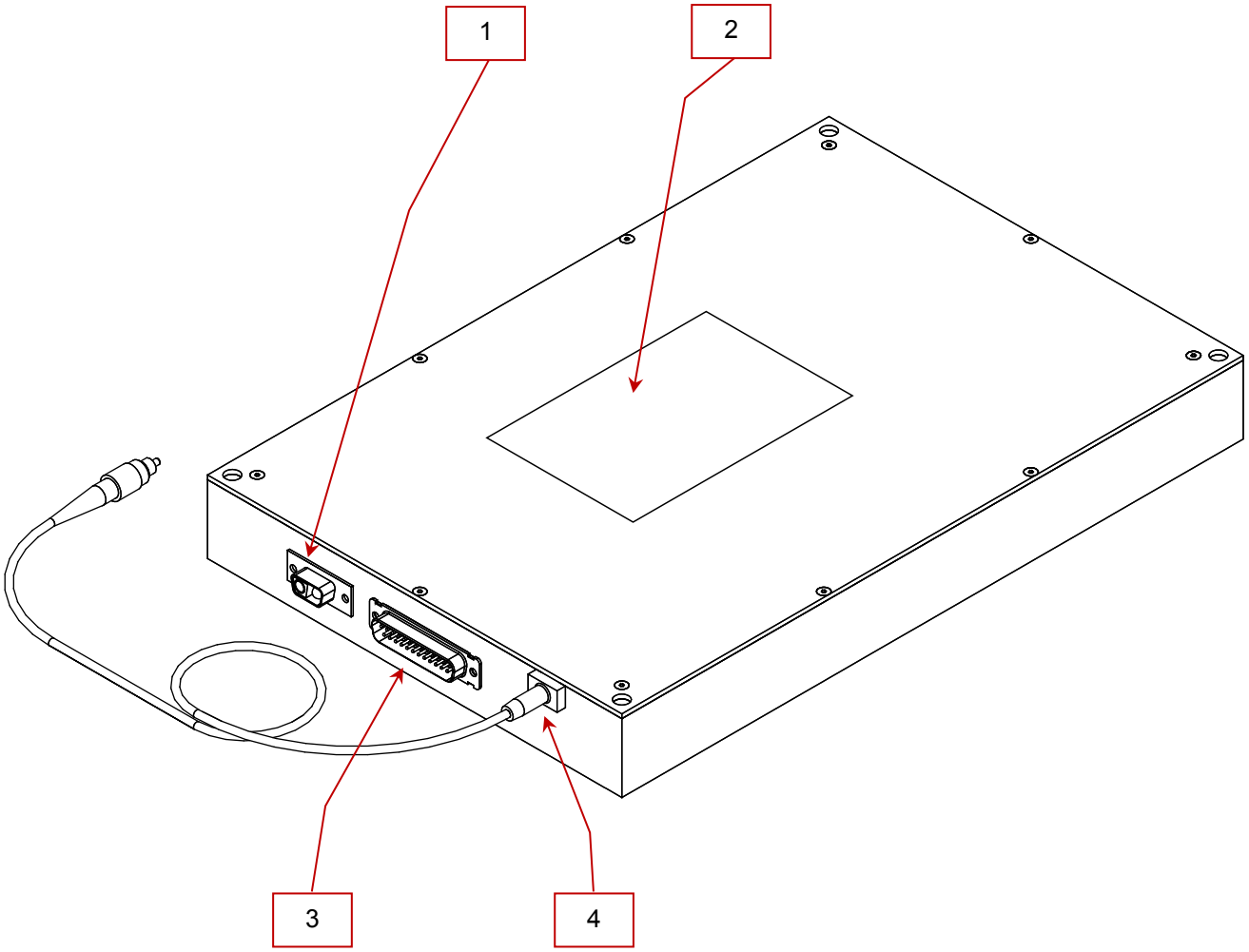
3. Design of the Device

3.1. Device overview

3.1.1. Overview



N#	Designation	Description
1	Power supply	Sub-DW connector. See §3.1.2 for more information.
2	Laser caution	European and US label about laser class and power
3	Control	Sub-D25 connector. See §3.1.2 for more information.
4	Optical Output	Output pigtail

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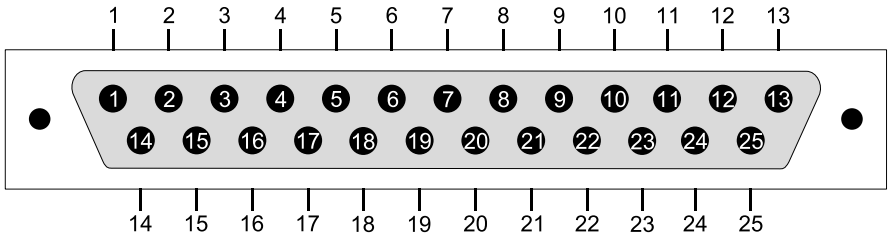
3.1.2. PIN assignment

Sub-D25 (male):



Pin #	Designation	Description
1	RS-232 RX	Serial Input for RS-232 protocol. See §5 for specifications
2	RS-232 TX	Serial Output for RS-232 protocol. See §5 for specifications
3	Not used	
4	Not used	
5	Not used	
6	Not used	
7	GND	
8	Not used	
9	Not used	
10	Not used	
11	Not used	
12	Not used	
13	Not used	
14	RS-232 GND	GND for serial transmission.
15	Not used	
16	Not used	
17	Not used	
18	Not used	
19	Not used	
20	Output Power Disable	TTL Input. High level disables laser emission. See §4.1.2 for specifications
21	Not used	
22	Not used	
23	Not used	
24	Not used	
25	Not used	

Example of interface cable:

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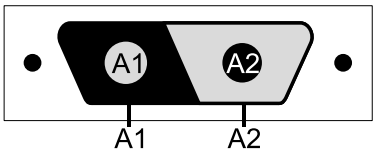
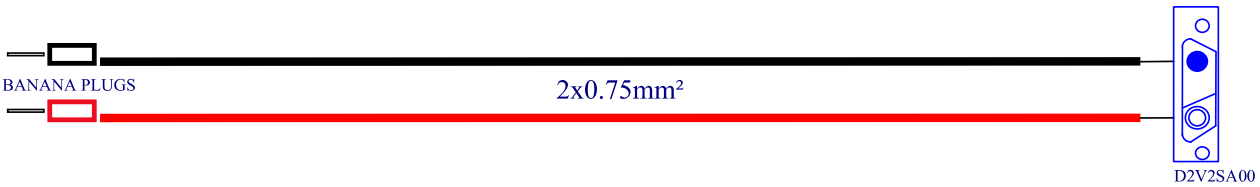
Sub-DW (female):



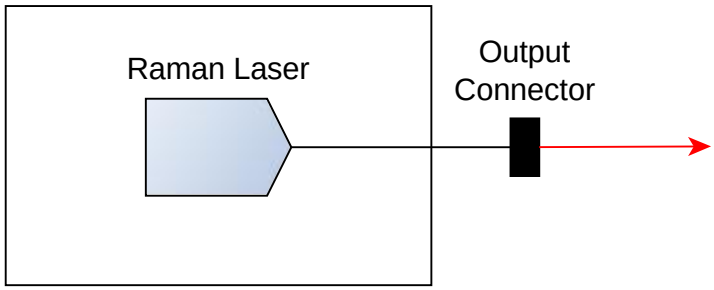
Pin #	Designation	Description
1	Ground	Ground for power supply.
2	Power Supply	Device power supply. See §4.1.1 for mor information.

Example of interface cable:

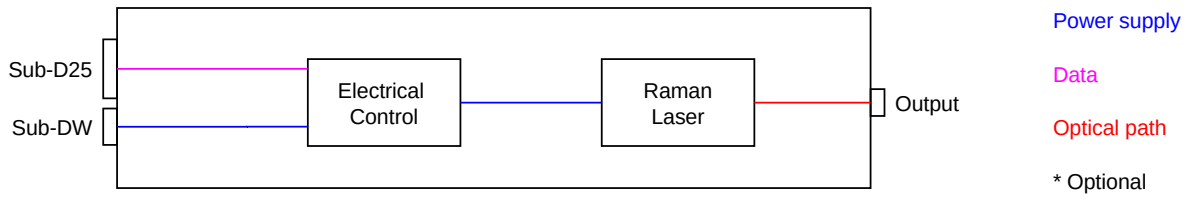


3.2. Design of the Device

3.2.1. Optical Design



3.2.2. Electrical Design



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3.2.3. Automatic Shutdown

To prevent any damage on the device we have implement some automatic shutdown. When one of these conditions is activated, the device immediately shutdown and cannot be start up while the problem is not solved.

Description	*Activation condition*	*Availability*
	Power	
Loss of input power	If input power is lower than keopsys configuration	Only if input monitoring is present
Loss of output power	If outpout power is lower than specification	Only if output monitoring is present
Feedback power	If feedback power is higher than keopsys configuration	Only if feedback monitoring is present
	Temperature	
Case temperature too high	If case temperature is upper than 65°C	All devices
First stage diode temperature is out of range	If first stage diode temperature is upper than 40°C or lower than 15°C	Only if first stage diode is temperature contoled
Second stage diode temperature is out of range	If second stage diode temperature is upper than 40°C or lower than 15°C	Only if second stage diode is temperature contoled

3.3. Principle of regulation

The device offers several modes of operation:

- Automatic Current Control (ACC)
- Automatic Power Control (APC) – Optional

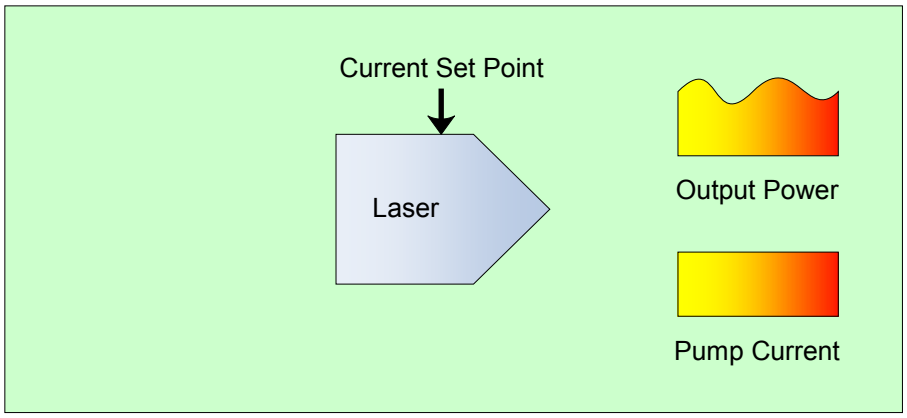
The ACC mode is available on all devices. The availability of other modes depends on the device, see device's test report or specifications for more information.

Following paragraphs describe these modes and the way that the electrical board drives the pump diodes.

3.3.1. Automatic Current Control (ACC)

In **Automatic Current Control** mode, the laser is controlled from the diodes current set point. The device is running in order to maintain a constant current through the pump laser diodes. A variation of internal optical parameter (due to temperature for example) will induce a variation of output power.

The maximum current of pump diodes is indicated on product test report.



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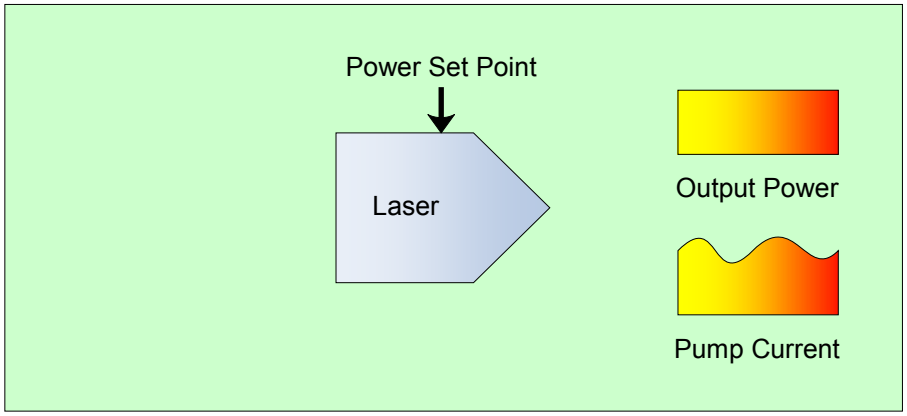
3.3.2. Automatic Power Control (APC) – Optional

In **Automatic Power Control** mode, the laser is regulated at a fixed output power set point.

The device is running in order to maintain a constant optical output power monitored with a photodiode. The current of the pump laser diode is adjusted to drive a constant output power. Depending of the number of pump laser diodes, electronic regulation is quite different for one pump diode and two pump diodes configuration.

The maximum output power set point is indicated on product test report.



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4. Device specification

4.1. Electrical specification

4.1.1. Power Supply

DESIGNATION	Comment	MIN	TYP	MAX	UNITS
Power Supply Voltage	Positive power supply	11	24	25	V

4.1.2. Input

DESIGNATION	Parameter	MIN	TYP	MAX	UNITS
Output Power Disable	Type		TTL		
	Low Level	0	-	0.5	V
	High Level	2.5	3.6	5	V
	Internal Pull up @ 3.6V	-	1k	-	Ohms

4.1.3. Output

No electrical output is available on this device.

4.2. Mechanical Specifications

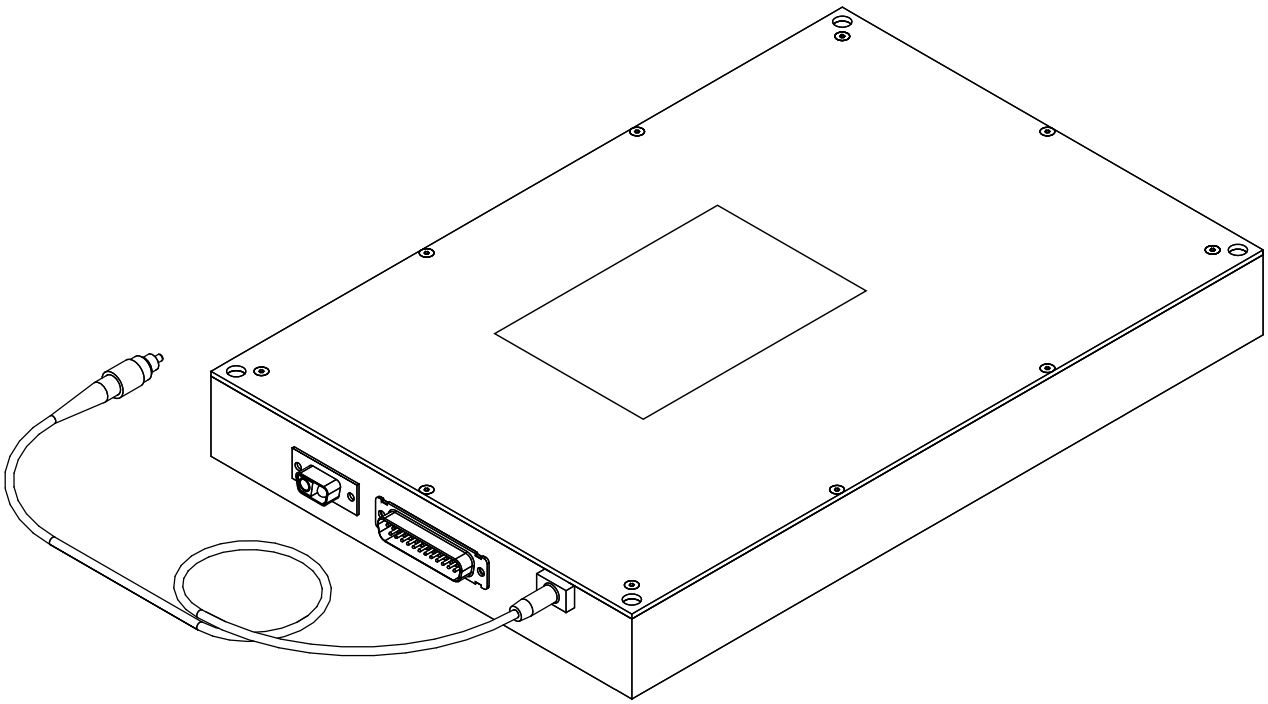

Fig. 1: Device Overview

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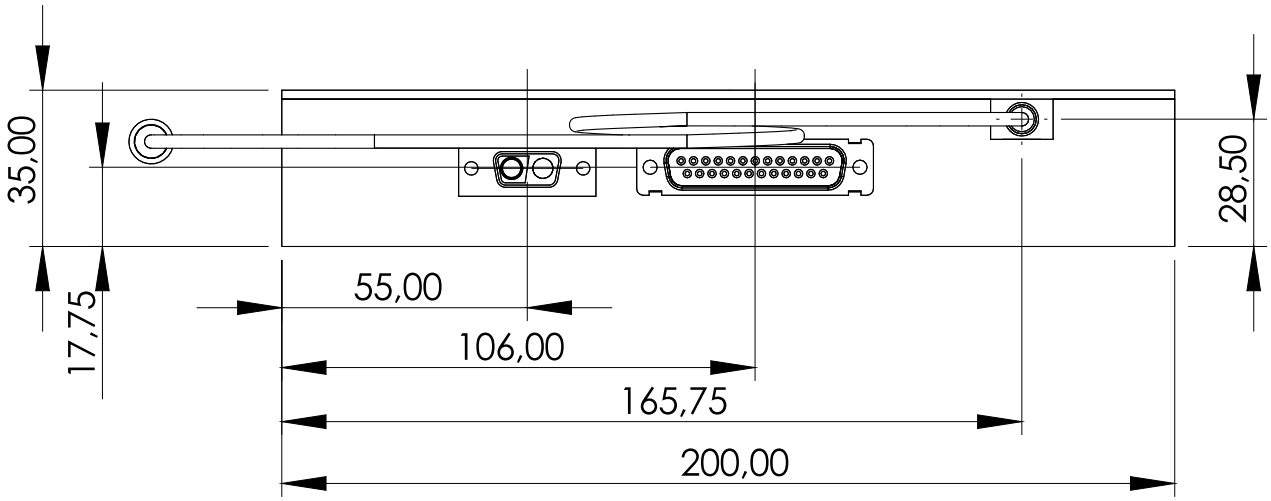

Fig. 2: Front view

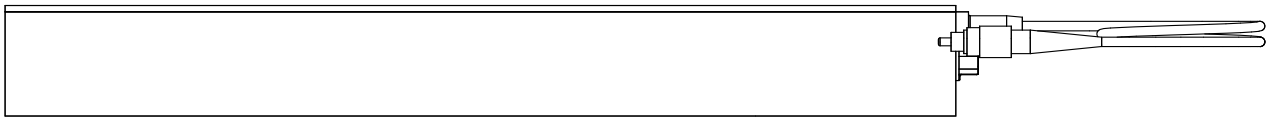

Fig. 3: Side view

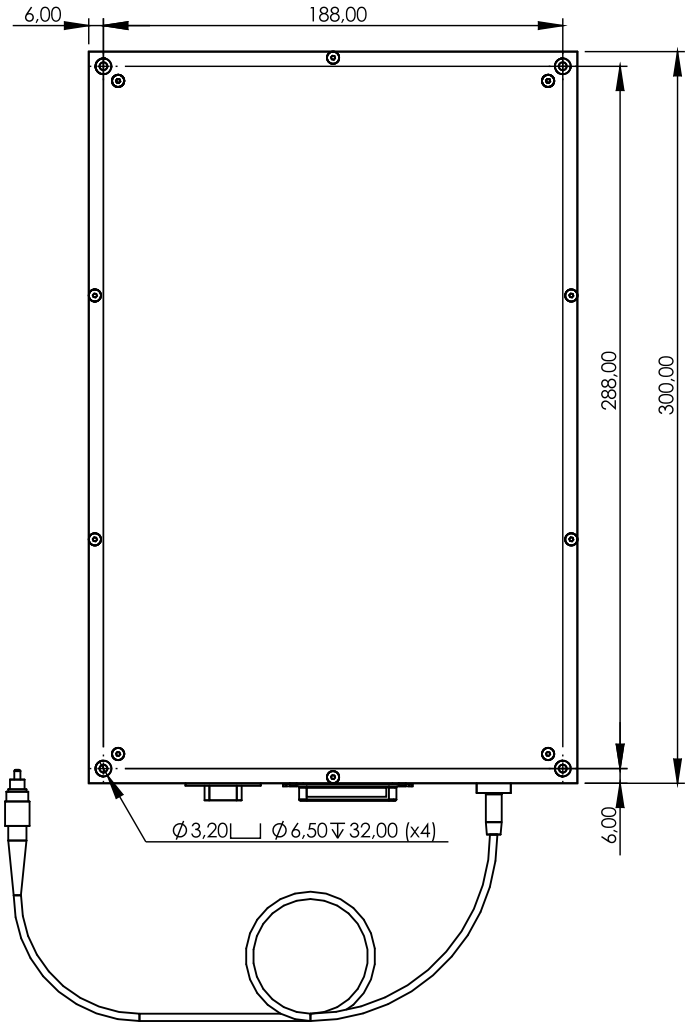

Fig. 4: Top view

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5. Remote control

This section describes the serial communication with the device. All information refers to the firmware version 2.41, if your device has a different firmware version, some differences may happen.

5.1. RS232 Protocol

To be able to communicate with the device you have to configure the RS232 connection like:

Parameter	Value
Baud rate	19200bps
Number of bits	8bits
Stop bit	1
Parity	None
Handshaking	None

5.2. Commands

The following commands are available for the device:

RS232 Commands

Cmd.	Description	Nb Char	Example	Ex. Answer	Unit	Information
			Global Commands			
SNU?	Read Serial Number	7	SNU?	SNU=1234567		
VER?	Read Firmware Version	9	VER?	VER=6.5/V2.41		
ASS?	Read the control mode	1	ASS?	ASS=1		See §4.3
ASS=	Write the control mode	1	ASS=1	ASS!		
TCR?	Read the case temperature	4	TCR?	TCR=2500	1/100°C	
PNO?	Read the nominal output power	2	PNO?	PNO=30	dBm	
RKP=1	Recover factory settings		RKP=1	RKP!		
			Monitoring			
PUE?	Read the actual input power	4	PUE?	PUE=1000	1/100dBm or mW	Optional
IC1?	Read the preamplifier diode current set point	4	IC1?	IC1=1000	mA	
IC1=	Write the preamplifier diode current set point	4	IC1=1000	IC1!	mA	Optional
ID1?	Read the actual booster diode current	4	ID1?	ID1=1000	mA	
TD1?	Read the actual preamplifier diode temperature	4	TD1?	TD1=2500	1/100°C	If preamplifier diode is cooled
IC2?	Read the booster diode current set point	4	IC2?	IC2=6000	mA	
IC2=	Write the booster diode current set point	4	IC2=6000	IC2!	mA	See test report for maximum value
ID2?	Read the actual booster diode current	4	ID2?	ID2=6000	mA	
TD2?	Read the actual booster diode temperature	4	TD2?	TD2=2500	1/100°C	If booster diode is cooled
CPU?	Read the output power set point	3	CPU?	CPU=300	1/10dBm	
CPU=	Write the output power set point	3	CPU=300	CPU!	1/10dBm	See test report for maximum value

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PUS?	Read the actual output power	4	PUS?	PUS=3000	1/100dBm or mW	
Alarms & Security						
ALA?	Read Alarms	4	ALA?	ALA=ABCD	Hexa	See §4.4
KEY?		1	KEY?	KEY=1	0/1	0 = OFF; 1 = ON
PUMP?	Read state of pump	1	PUMP?	PUMP=1	0/1	0 = OFF; 1 = ON
ASI?	Read the automatic shutdown threshold for low input power	3	ASI?	ASI=-5	dBm	Optional
ASF?	Read the automatic shutdown threshold for high feedback power	3	ASF?	ASF=5	dBm	Optional

The electrical board answer is ended by:	
!	OK
*	Command unknown
#	Not authorized

5.3. Mode of operation

Mode of operation meaning		
Value	***Name***	***Description***
0	OFF	Pumps diodes are off. Attention: it doesn't mean that laser emission is disabled.
1	ACC	Automatic Current Control. See §2.4.1 for more information.
2	APC	Automatic Power Control. See §2.4.2 for more information. *Optional*

5.4. Alarms and Warning description

The answer returned by ALA command is an hexadecimal value of 4 characters. You have to convert it in binary and read the activated alarms using following table:

Alarms meaning			
Bit N#	***Type***	***Description***	***"ON" conditions***
15	Warning	Pumps are disabled	When pumps are off
14	Alarm	Loss of output power	The output power is too low compared with the actual pump diode current
13	Alarm	Loss of input power OR High feedback power	The input power is too low compared with the input power threshold OR the feedback power is too high compared feedback power threshold.
12	Warning	Case temperature out of range	Temperature > 85°C
11	Alarm	Second diode temperature out of range	Value < 15°C or Value > 40°C
10	Warning	Second TEC current is too high	
9	Alarm	First diode temperature out of range	Value < 15°C or Value > 40°C
8	Warning	First TEC current is too high	

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7	Warning	Problem on second diode current	Instantaneous current < 8/9 of set point. Attention : this warning appear when the pump emission is enable but should disapear when current has reach the set point. If the warning stay On contact Keopsys.
6		Not used	
5	Warning	Problem on first diode current	Instantaneous current < 8/9 of set point. Attention : this warning appear when the pump emission is enable but should disapear when current has reach the set point. If the warning stay On contact Keopsys.
4		Not used	
3	Alarm	Key Off	Key on front panel is on 0 position
2		Not used	
1	Warning	Second diode temperature far from set point	Value > +/- 2°C of set point
0	Warning	First diode temperature far from set point	Value > +/- 2°C of set point

Alarm = pump diodes are shutdown; Warning = Information only

Remark : bit #15 is the Most Significant Bit (MSB) and bit #0 is the Least Significant Bit (LSB).

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6. Human Interface

An optional cable or interface box can be provided with the device. Refer to its manual for more information.

7. Warranty

7.1. Default Warranty

This Keopsys product is guaranteed against defects in material and workmanship for 12 months from the date of shipment. Keopsys will either repair or replace products that prove to be defective.

For warranty or repair, return this product to Keopsys. The buyer will prepay shipping charges to Keopsys, and Keopsys will pay shipping to return the product to the buyer. However, the buyer will pay all shipping charges, duties and taxes for products returned to Keopsys from any foreign country.

7.2. Limitation of warranty

ATTENTION

WARRANTY VOID if the device is opened

- Never use the device to application not described in this manual.
- Never open or modify the product.
- Use the device with properly cleaned connector (refer to safety recommendations when cleaning the fiber connectors).
- Store and use the device in an ESD free environment for unpacking, assembly, maintenance and shipment for warranty.

The foregoing warranty will not apply to defects resulting from abuse, misuse, neglect, improper installation or application by the buyer.

Keopsys will not be responsible for the damage caused to the device as a result of employing dirty or incompatible fiber connectors.

8. Assistance

Should a problem occur, contact Keopsys. A Return Material Authorization (RMA) number will be issued for any faulty unit that needs to be returned. Note this number on the shipping container and on all correspondence.

For assistance, or before any shipments, please contact Keopsys:

Contact

www.keopsys.com

after-sales@keopsys.com

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